Macroeconomics
The Basic Tools of Finance

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*In this chapter,
look for the answers to these questions:*

- What is "present value"? How can we use it to compare sums of money from different times?

- Why are people risk averse?
  How can risk-averse people use insurance and diversification to manage risk?

- What determines the value of an asset?
  What is the "efficient markets hypothesis"?
  Why is beating the market nearly impossible?

Introduction

- The financial system coordinates saving and investment.
- Participants in the financial system make decisions regarding the allocation of resources over time and the handling of risk.
- Finance is the field that studies such decision making.

Present Value: The Time Value of Money

- To compare sums from different times, we use the concept of present value.

- The **present value** of a future sum: the amount that would be needed today to yield that future sum at prevailing interest rates

- Related concept:
  The **future value** of a sum: the amount the sum will be worth at a given future date, when allowed to earn interest at the prevailing rate

EXAMPLE 1: A Simple Deposit

- Deposit $100 in the bank at 5% interest. What is the future value (FV) of this amount?

- In N years, FV = $100(1 + 0.05)^N$

- In one year, FV = $100(1 + 0.05) = $105.00

- In two years, FV = $100(1 + 0.05)^2 = $110.25

- In three years, FV = $100(1 + 0.05)^3 = $115.76

EXAMPLE 1: A Simple Deposit

- Deposit $100 in the bank at 5% interest. What is the future value (FV) of this amount?

- In N years, FV = $100(1 + 0.05)^N$

- In this example, $100 is the present value (PV).

- In general,   FV = PV(1 + r)^N
  where r denotes the interest rate (in decimal form).

- Solve for PV to get: PV = FV/(1 + r)^N

EXAMPLE 2: Investment Decision

Present value formula: $PV = FV/(1 + r)^N$

- Suppose $r = 0.06$.
  Should General Motors spend $100 million to build a factory that will yield $200 million in ten years?

Solution:

Find present value of $200 million in 10 years:

$PV = (\$200 \text{ million})/(1.06)^{10} =$ $112 million

Since PV > cost of factory, GM should build it.

EXAMPLE 2: Investment Decision

- Instead, suppose r = 0.09.
  Should General Motors spend $100 million to build a factory that will yield $200 million in ten years?

Solution:
   Find present value of $200 million in 10 years:

   PV = ($200 million)/$(1.09)^{10}$ = $84 million

   Since PV < cost of factory, GM should not build it.

   Present value helps explain why
   investment falls when the interest rate rises.

You are thinking of buying a six-acre lot for $70,000. The lot will be worth $100,000 in five years.

A. Should you buy the lot if r = 0.05?
PV = $100,000/(1.05)^5 = $78,350.
PV of lot > price of lot.
Yes, buy it.

B. Should you buy it if r = 0.10?
PV = $100,000/(1.1)^5 = $62,090.
PV of lot < price of lot.
No, do not buy it.

Compounding

- **Compounding**: the accumulation of a sum of money where the interest earned on the sum earns additional interest

- Because of compounding, small differences in interest rates lead to big differences over time.

- Example: Buy $1000 worth of Microsoft stock, hold for 30 years.

  If rate of return = 0.08, FV = $10,063
  If rate of return = 0.10, FV = $17,450

The Rule of 70

- The Rule of 70:
  If a variable grows at a rate of *x* percent per year, that variable will double in about 70/*x* years.

- Example:
  - If interest rate is 5%, a deposit will double in about 14 years.
  - If interest rate is 7%, a deposit will double in about 10 years.

Risk Aversion

- ALL people are **risk averse**—they dislike uncertainty.

- Example: You are offered the following gamble. Toss a fair coin.
  - If heads, you win $1000.
 - If tails, you lose $1000.

  Should you take this gamble?

- If you are risk averse, the pain of losing $1000 would exceed the pleasure of winning $1000, and both outcomes are equally likely, so you should not take this gamble.

The Utility Function

Utility is a subjective measure of well-being that depends on wealth.

As wealth rises, the curve becomes flatter due to **diminishing marginal utility**:

the more wealth a person has, the less extra utility he would get from an extra dollar.

Utility

Current utility
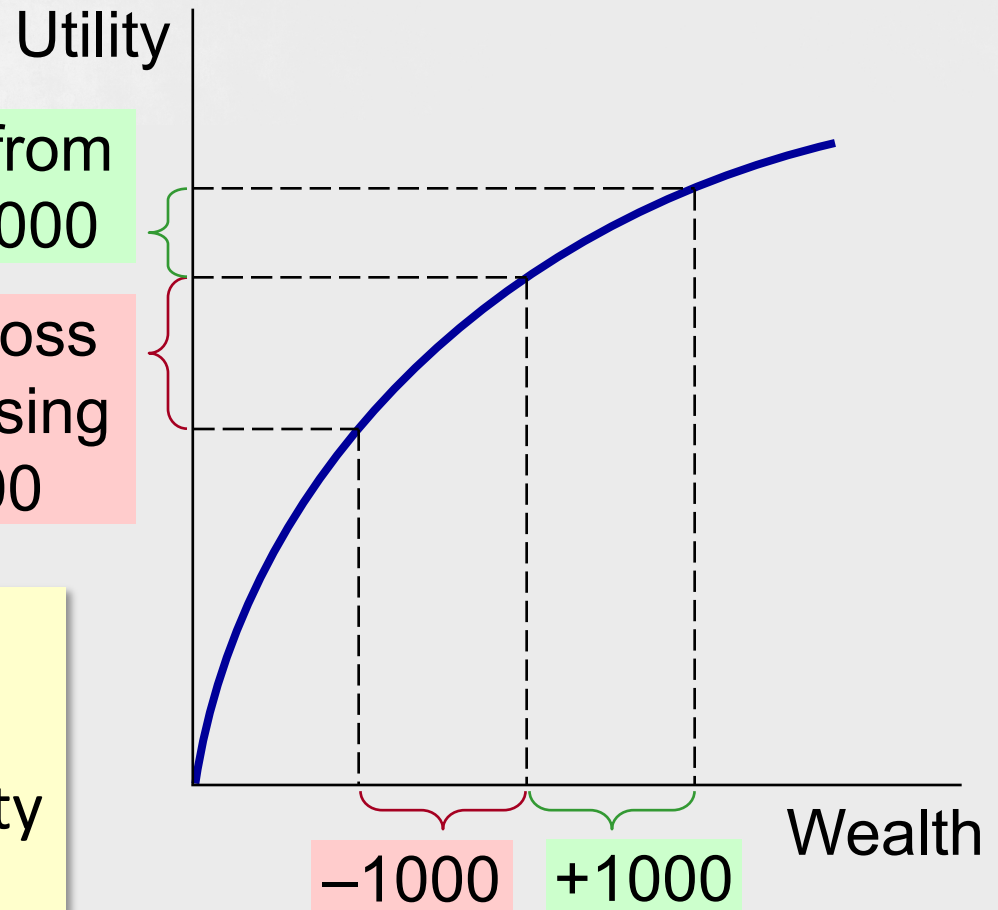
Wealth

Current wealth
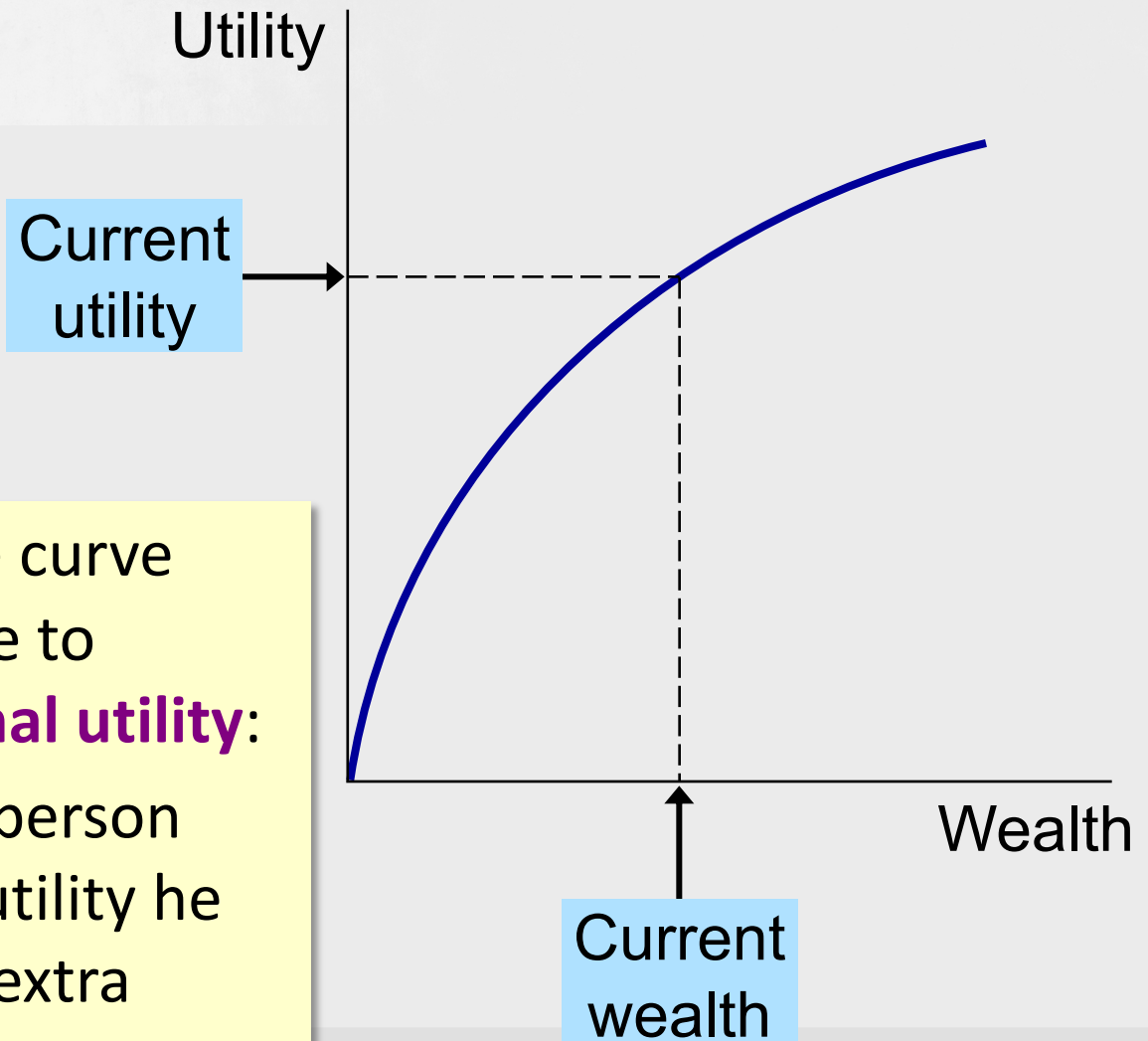
The Utility Function and Risk Aversion

Utility

Utility gain from winning $1000

Utility loss from losing $1000

Because of diminishing marginal utility, a $1000 loss reduces utility more than a $1000 gain increases it.

−1000   +1000

Wealth

Managing Risk With Insurance

- How insurance works:
  A person facing a risk pays a fee to the insurance company, which in return accepts part or all of the risk.

- Insurance allows risks to be pooled, and can make risk averse people better off:

  E.g., it is easier for 10,000 people to each bear 1/10,000 of the risk of a house burning down than for one person to bear the entire risk alone.

Two Problems in Insurance Markets

1. **Adverse selection**:
   A high-risk person benefits more from insurance, **if the insurance company doesn't know it**, so is more likely to purchase it.

2. **Moral hazard**:
   People with insurance have less incentive to avoid risky behavior.

Insurance companies cannot fully guard against these problems, so they must charge higher prices.

As a result, low-risk people sometimes forego insurance and lose the benefits of risk-pooling.

Adverse selection or moral hazard?

Identify whether each of the following is an example of adverse selection or moral hazard.

A. Joe begins smoking in bed after buying fire insurance.

B. Both of Susan's parents lost their teeth to gum disease, **and Susan hasn't told the insurance company**, so Susan buys dental insurance.

C. When Gertrude parks her Corvette convertible, she doesn't bother putting the top up, because her insurance covers theft of any items left in the car.

Answers

A. Joe begins smoking in bed after buying fire insurance.

moral hazard

B. Both of Susan's parents lost their teeth to gum disease, so Susan buys dental insurance.

adverse selection

C. When Gertrude parks her Corvette convertible, she doesn't bother putting the top up, because her insurance covers theft of any items left in the car.

moral hazard

Clicker question!

Joe rides a motorcycle. It's a problem of moral hazard if

A. He doesn't have insurance and drives carelessly.

B. He has insurance and drives carefully.

C. He has insurance and drives carelessly.

D. He has insurance and drives more carelessly than he would have if he didn't have insurance.

Another clicker question!

Joe (our favorite insuree) smokes. It's a problem of adverse selection if

A. He doesn't tell his health insurer that he smokes.

B. He doesn't have health insurance.

C. He tells his health insurer that he smokes and the health insurer charges him more for insurance.

D. His health insurer doesn't cover him for smoking-related illnesses.

Measuring Risk

- We can measure the risk of an asset with the **standard deviation**, a statistic that measures a variable's volatility—how likely it is to fluctuate.

- The higher the standard deviation of the asset's return, the greater the risk.

- You'll learn lots more about the standard deviation, which is the fundamental statistical measurement of distance, in Econ 3818.

Reducing Risk Through Diversification

- **Diversification** reduces risk by replacing a single risk with a large number of smaller, unrelated risks.

- A diversified portfolio contains assets whose returns are not strongly related:
  - Some assets will realize high returns, others low returns.
  - The high and low returns average out, so the portfolio is likely to earn an intermediate return more consistently than any of the assets it contains.
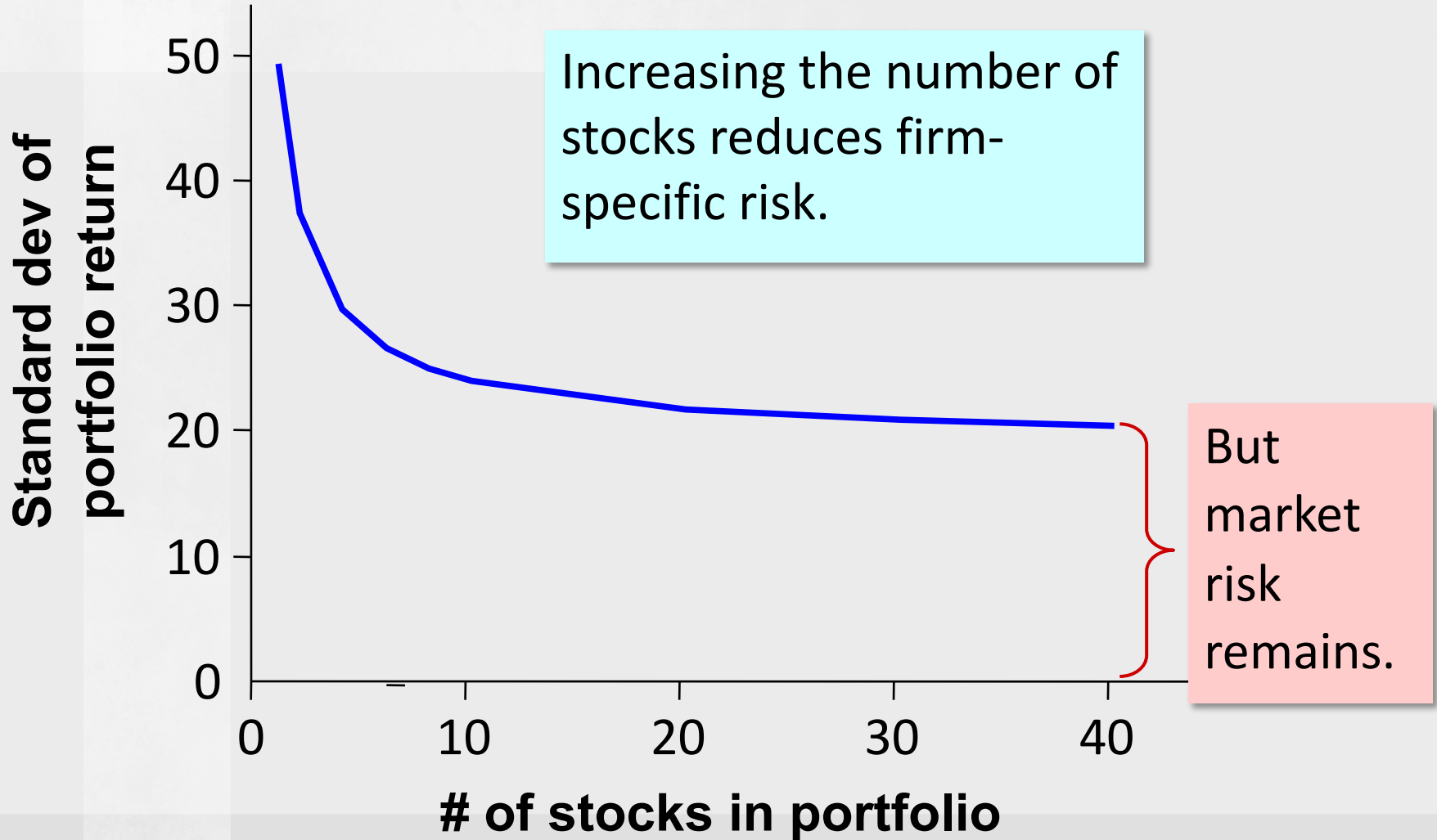
Reducing Risk Through Diversification

- Diversification can reduce **firm-specific risk**, risks that pertain to the profitability of individual companies.

- Diversification *cannot* reduce **market risk**, risks that affect all companies in the stock market.

Reducing Risk Through Diversification

Y-axis: **Standard dev of portfolio return** (0, 10, 20, 30, 40, 50)

X-axis: **# of stocks in portfolio** (0, 10, 20, 30, 40)

Increasing the number of stocks reduces firm-specific risk.

But market risk remains.

The Tradeoff Between Risk and Return

- Tradeoff:
  Riskier assets pay a higher return, on average,
  to compensate for the extra risk of holding them.

- E.g., over past 200 years, average real return on stocks, 8%. On short-term govt bonds, 3%.
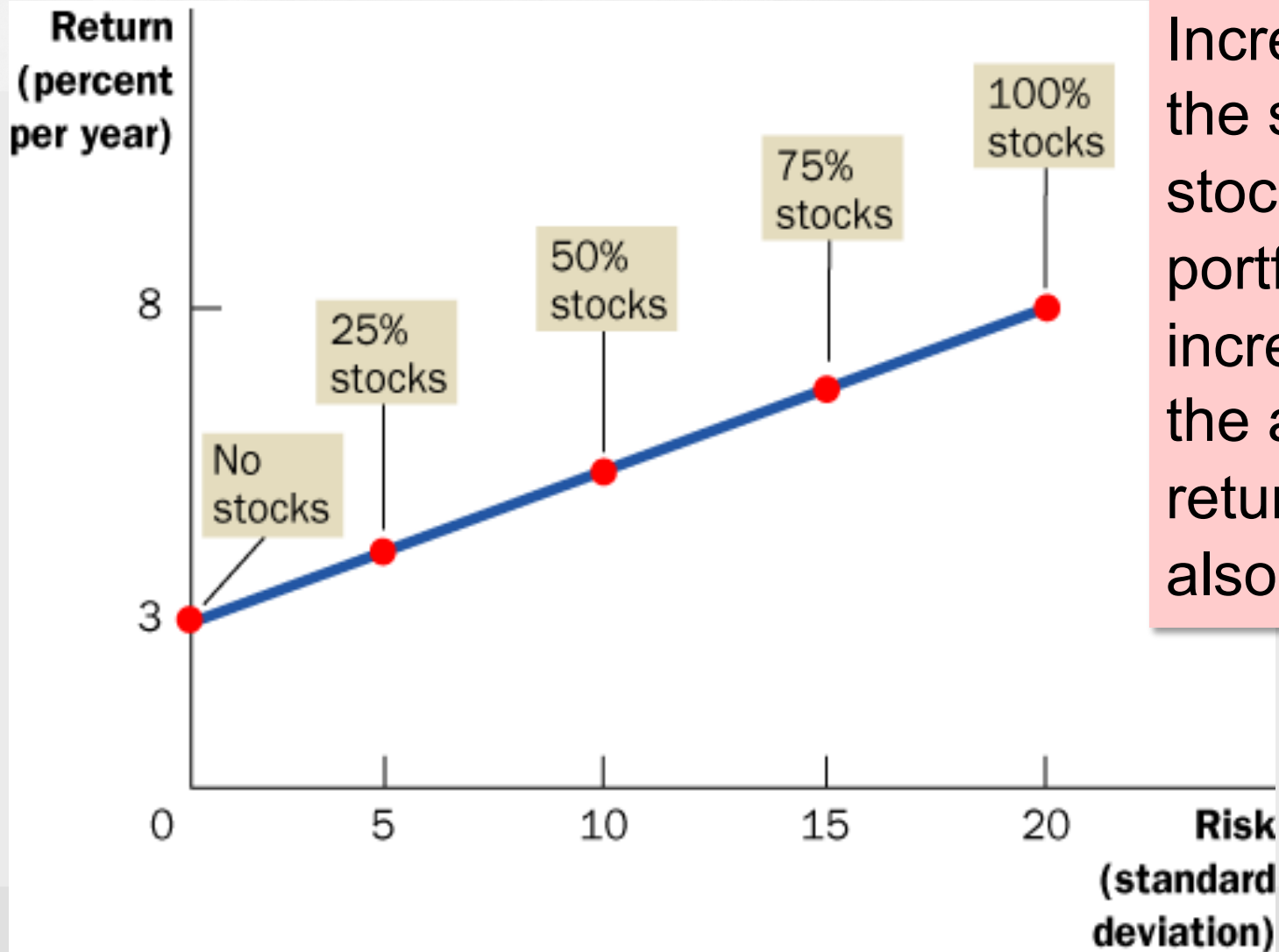
The Tradeoff Between Risk and Return

- Example:
  Suppose you are dividing your portfolio between two asset classes.

  - A diversified group of risky stocks:
    average return = 8%, standard dev. = 20%

  - A safe asset:
    return = 3%, standard dev. = 0%

- The risk and return on the portfolio depends on the percentage of each asset class in the portfolio…

The Tradeoff Between Risk and Return

Increasing the share of stocks in the portfolio increases the average return but also the risk.

Asset Valuation

- When deciding whether to buy a company's stock, you compare the price of the shares to the value of the company.

    - If share price > value, the stock is **overvalued**.

    - If price < value, the stock is **undervalued**.

    - If price = value, the stock is **fairly valued**.

Valuing a share of stock

If you buy a share of AT&T stock today,

- you will be able to sell it in 3 years for $30.

- you will receive a $1 dividend at the end of each of those 3 years.

If the prevailing interest rate is 10%,
what is the value of a share of AT&T stock today?

Answers

amount you will receive	when you will receive it	present value of the amount
$1	in 1 year	$1/(1.1) = $ .91
$1	in 2 years	$1/(1.1)^2 = $ .83
$1	in 3 years	$1/(1.1)^3 = $ .75
$30	in 3 years	$30/(1.1)^3 = $22.54

The value of a share of AT&T stock equals
the sum of the numbers in the last column: **$25.03**

Asset Valuation

- Value of a share
  = PV of any dividends the stock will pay
  + PV of the price you get when you sell the share

- Problem: When you buy the share, you don't know what future dividends or prices will be.

- One way to value a stock: **fundamental analysis**, the study of a company's accounting statements and future prospects to determine its value

Show of hands survey

You have a brokerage account with Merrill Lynch. Your broker calls you with a hot tip about a stock: new information suggests that the company will be highly profitable.

Should you buy stock in the company?

A. Yes

B. No

C. Not until you read the prospectus.

D. What's a prospectus?

The Efficient Markets Hypothesis

- **Efficient Markets Hypothesis (EMH)**: the theory that each asset price reflects all publicly available information about the value of the asset

Implications of EMH

1. Stock market is **informationally efficient**:
   Each stock price reflects all available information about the value of the company.

2. Stock prices follow a **random walk**:
   A stock price only changes in response to new information ("news") about the company's value. News cannot be predicted, so stock price movements should be impossible to predict.

3. It is impossible to systematically beat the market. By the time the news reaches you, mutual fund managers will have already acted on it.

The Efficient Markets Hypothesis, revisited

- **Efficient Markets Hypothesis (EMH)**: the theory that each asset price reflects all **publicly available** information about the value of the asset

- Turned out, in the last recession, that most of the relevant information wasn't public

- In fact, lots of it had been deliberately concealed.

- EMH isn't much good for predicting actual market outcomes, at least in crises.

Index Funds vs. Managed Funds

- An **index fund** is a mutual fund that buys all the stocks in a given stock index.

- An actively managed mutual fund aims to buy only the best stocks.

- Actively managed funds have higher expenses than index funds.

- EMH implies that returns on actively managed funds should not consistently exceed the returns on index funds.

Index Funds vs. Managed Funds

	2001–2006 annualized return	2006 expense ratio
S&P 500 (index fund)	6.2%	.351
Managed large cap funds	5.9	1.020
S&P MidCap 400 (index fund)	10.9	.535
Managed mid cap funds	8.1	1.458
S&P SmallCap 600 (index fund)	12.5	.550
Managed mid cap funds	10.3	1.272

Market Irrationality

- Many believe that stock price movements are partly psychological:
  - J.M. Keynes: stock prices driven by "animal spirits," "waves of pessimism and optimism"
  - Alan Greenspan: 1990s stock market boom due to "irrational exuberance"

- **Bubbles** occur when speculators buy overvalued assets expecting prices to rise further.

- The importance of departures from rational pricing is not known.

CONCLUSION

- This chapter has introduced some of the basic tools people use when they make financial decisions.

- The efficient markets hypothesis teaches that a stock price should reflect the company's expected future profitability.

- Fluctuations in the stock market have important macroeconomic implications, which we will study later in this course.

SUMMARY

- The present value of any future sum is the amount that would be needed today, given prevailing interest rates, to produce that future sum.

- Because of diminishing marginal utility of wealth, most people are risk-averse. Risk-averse people can manage risk with insurance, through diversification, and by choosing a portfolio with a lower risk and lower return.

SUMMARY

- The value of an asset equals the present value of all payments its owner will receive. For a share of stock, these payments include dividends plus the final sale price.

- According to the efficient markets hypothesis, financial markets are informationally efficient, a stock price always equals the market's best guess of the firm's value, and stock prices follow a random walk as new information becomes available.

SUMMARY

- Some economists question the efficient markets hypothesis, and believe that irrational psychological factors also influence asset prices.